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DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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DEPARTMENT OF COMMERCE - BUREAU OF MINES

THE BUREAU OF MINES COAL-SAMPLING TRUCK[1]

By R. H. Kudlich[2]

In order to assist the various Federal and State agencies using large quantities of coal to select coal best suited technically and economically to their use, the United States Bureau of Mines has placed at their disposal a fuel inspection service. As part of this service, inspections are made at the mines which propose to furnish coal to these agencies on contracts. Such inspections cover both the mine itself to ascertain its capacity to furnish the desired tonnage and quality of the coal, the preparation of the coal in the tipple, and the obtaining of samples for analysis to determine the quality of coal as shipped.

To insure that the sample sent to the laboratory for analysis is representative of the average quality of the coal, increments are taken at intervals until a gross sample of about 1,000 pounds of coal has been collected from each of the sizes of coal shipped by the mine, while coal has been coming from all parts of the mine. In reducing this gross sample to the small sample which is sent to the laboratory for analysis it is necessary to crush and quarter the coal by a certain standardized method until only 5 or 6 pounds of coal small enough to pass through a 3/16-inch square-mesh screen remains. The ordinary method which the bureau has followed was to crush the coal by hand with a tamper, such as is used for tamping concrete, on some hare smooth surface and to reduce the volume by quartering and riffling.

During the past few years the demands from various Federal and State agencies for this service have been increasing rapidly in respect to bituminous coals. In addition to this, which might be called the normal increase, numerous requests have been received for similar service in respect to anthracite. It was obvious that if this increased demand was to be met it would be necessary either to increase the force allotted to this work or to provide the present force with some means by which their work could be made more effective. A careful survey of the situation showed that the greatest amount of time was consumed in transporting the men and their equipment from mine to mine in the same district, and in reducing the gross sample to the small finely crushed sample which is to be sent to the laboratory. Both of these phases of the work could be greatly accelerated by providing a motor truck of suitable speed and capacity, carrying a power-operated crusher, and the proper auxiliary equipment to store the gross sample as collected and to reduce it in volume efficiently after it has been crushed. Such a truck has been provided and placed in service. In the eight months it has been in operation the desired results have been fully attained. About twice as many samples as usual have been taken during that time by the same 2-man crew assigned to this work.

Many of the mines in the eastern part of the United States are in hilly or mountainous regions and can be reached only over rough, practically unimproved roads. Hence the specifications for the truck were drawn to cover high-quality, long-life trucks, in order that time in the field would not be reduced by frequent trips to the garage for repair and overhauling. The estimated total weight of the truck body and fixed equipment was 4,800 pounds and the accessory equipment 550 pounds. However, a "body and pay load" capacity of 7,000 pounds was specified, since when in service one or two gross samples of about 1,000 pounds each are loaded on the truck platform, and also when the crusher is in operation it may set up violent vibrations if a heavy piece of slate or rock should become caught between hammers. When fully equipped the truck with its 2-man crew and their personal baggage weighs somewhat over 10,000 pounds.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is usee: "Reprinted from U. S. Bureau of Mines Information Circular 6545."

[2] Assistant to chief engineer, mechanical division, U. S. Bureau of Mines.

Figure 1 indicates the general arrangement of the truck and its equipment.

The truck body consisted of an underframe which serves as a bed plate for the crusher and engine and as a "backbone" for the truck body proper. The underframe is made of 6-inch steel channels, I beams and flats riveted and welded together to obtain maximum stiffness, the longitudinal members spaced to correspond with the longitudinal frame members of the chassis and the cross members to accommodate the crusher and engine. The body proper consists of a floor 6 feet 6 inches wide by 10 feet long with sides 20 inches high. The sides and tail gate are hinged, so that they may be lowered and supported in a horizontal position so as to form a platform approximately 10 feet wide and 11 feet 9 inches long. This gives ample working room and space in which to assemble two gross samples in the canvas bags in which they are collected. With the sides up, there is approximately 36 cubic feet of space available for carrying the auxiliary equipment, supplies, and personal baggage of the crew. While on the road, the entire body and equipment are covered with a fitted tent-shaped tarpaulin stretched over a ridge pole carried on two removable pipe stanchions.

A swing-hammer crusher fitted with 3/16-inch gratings was selected as having the proper capacity and crushing the coal to the fineness called for by the standard method for coal sampling. A welded sheet-steel hopper of proper size to receive the coal poured from the canvas bags has been added to the top of the crusher and a discharge hopper which fits into the riffle to the bottom. In order to conserve "head room" below the riffle, the discharge hopper was fitted up into the housing of the crusher as show in Figure 2.

The crusher has a rated capacity of 1,000 pounds per hour at a speed of 1100 r.p.m. It actually crushes a 1,000-pound sample of moderately hard bituminous run-of-mine coal in from 7 to 15 minutes and a 1,000-pound sample of $\frac{3}{4}$-inch slack in from 5 to 9 minutes.

The crusher is driven by a 20 hp. gasoline-engine power unit to which it is connected through a flexible coupling. The power unit is self-contained, consisting of a 4-cylinder 4-cycle gasoline engine with a forced-circulation water-cooling system, magneto ignition, self-starter, and with a clutch on the power take-off shaft. A mechanical governor holds the speed at about 1,200 r.p.m. Since a lot of dust is present in the air where the engine is to operate, the air inlet to the carburetor has been fitted with an oil-type air filter. The entire unit is enclosed in a weatherproof sheet-metal housing. The exhaust outlet in the top of the housing has been provided with an exhaust pipe of thin-walled steel tubing sufficiently long to discharge the products of combustion considerably above the breathing level of the man feeding the crusher. This pipe is made easily detachable to allow demounting when the truck is in transit.

A single-cylinder 2-inch diameter by 1½-inch stroke air compressor, belt driven through tight and loose pulleys from the power unit, supplies compressed air at a 100-pound pressure for cleaning out the crusher after a sample has been ground in order to prevent contamination of the next sample. Air is stored in a steel tank 18 inches in diameter and 22 inches long to clean the inside of the crusher and to dust off the outside of the crusher and power unit when the outfit is being cleaned ready to pack up.[3] An unloading device prevents the building up of excessive pressure.

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[3] Several months' experience has shown that this tank should have been somewhat larger.

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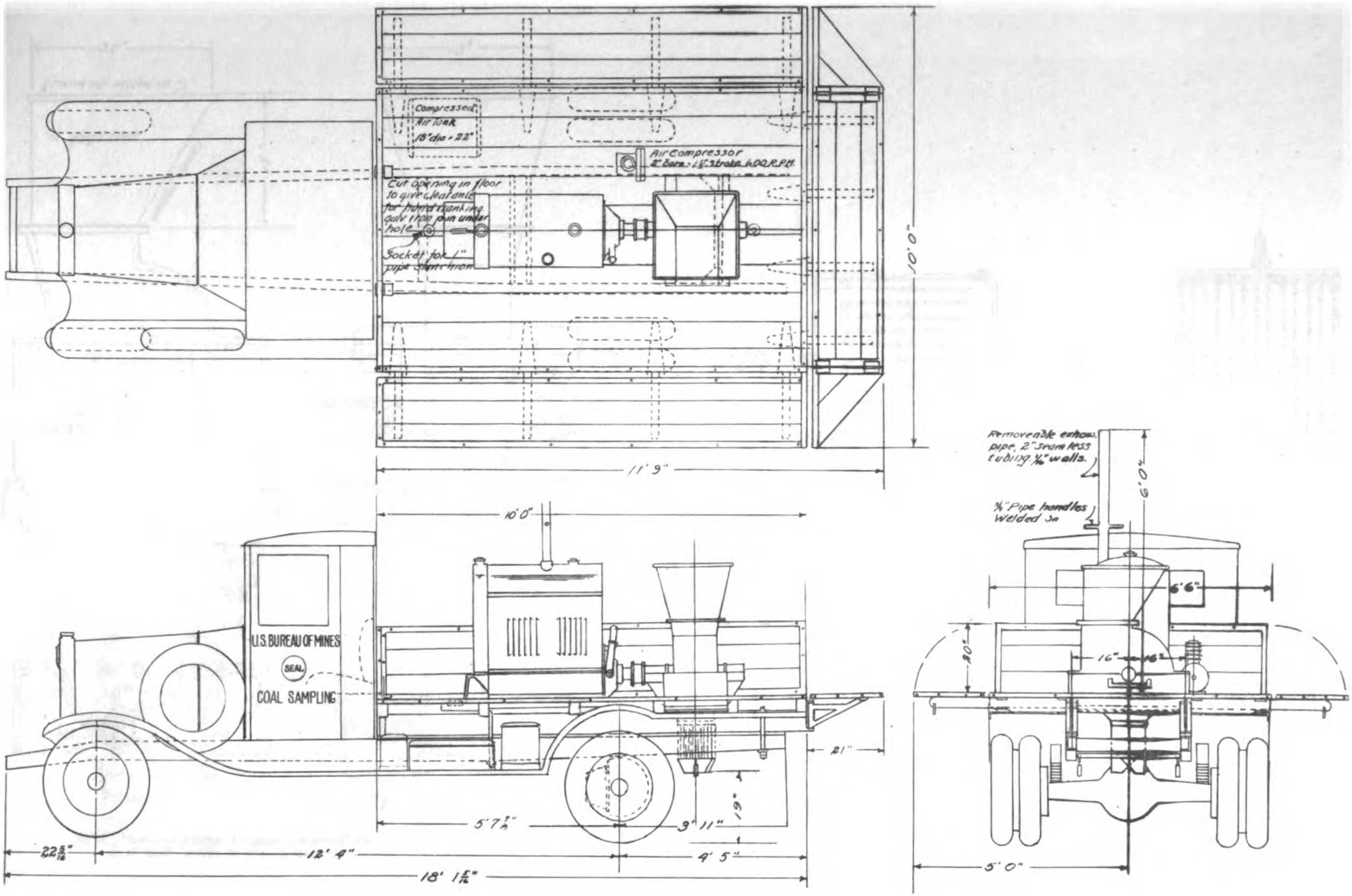
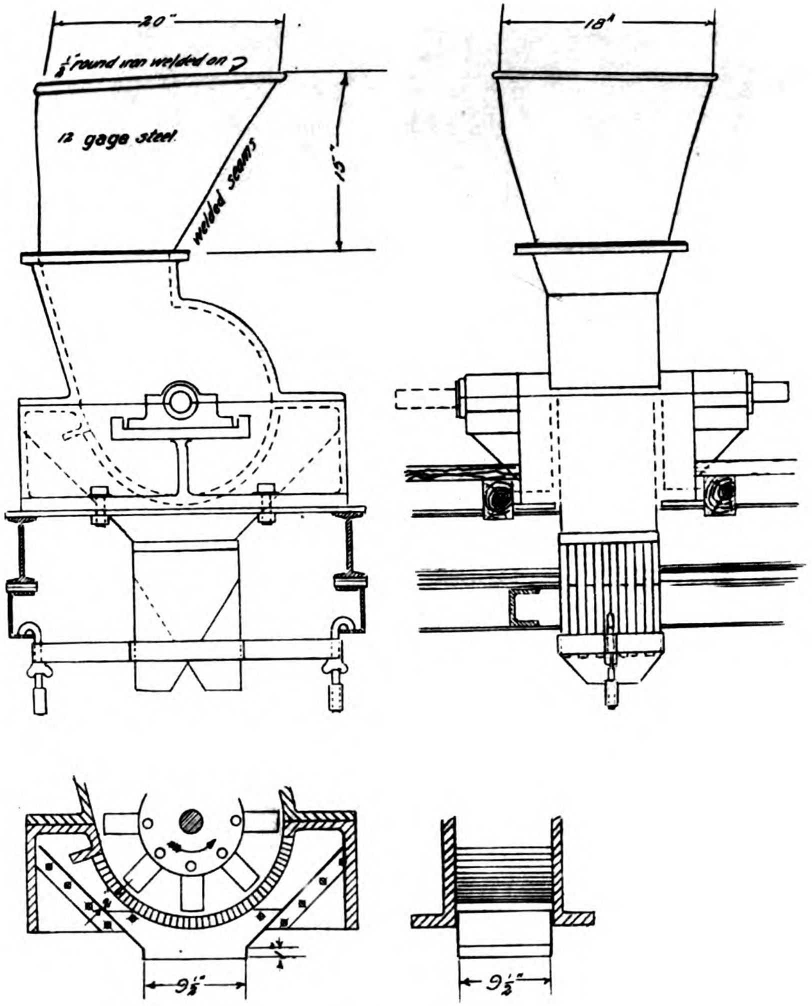

Compressed Air tank 18" dia × 22"
Air Compressor 2" Bore - 1½" Stroke 400 R.P.M.
Cut opening in floor to give clearance for hand cranking galv. iron pan under hole
Socket for 1" pipe stanchion
10' 0"
11' 9"
10' 0"
U.S. BUREAU OF MINES
SEAL
COAL SAMPLING
21"
19"
5' 7⅞"
3' 11"
22 5/16"
12' 4"
4' 5"
18' 1 5/16"
Removeable exhaus. pipe, 2" seamless tubing 1/16" walls.
¾" Pipe handles Welded on
6' 0"
6' 6"
30"
16"
16"
5' 0"

Figure 1.—General arrangement of truck



NOTE: Discharge hopper 16 gage galvanized iron to fit tightly inside of crusher housing

Figure 2.—Assembly of crusher, hoppers, and riffle

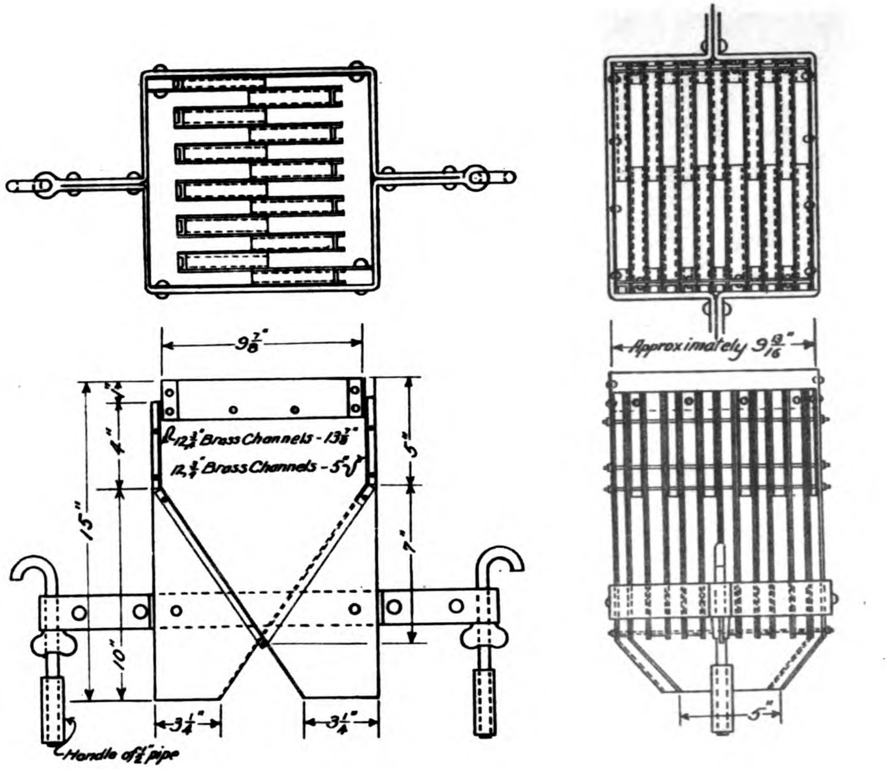
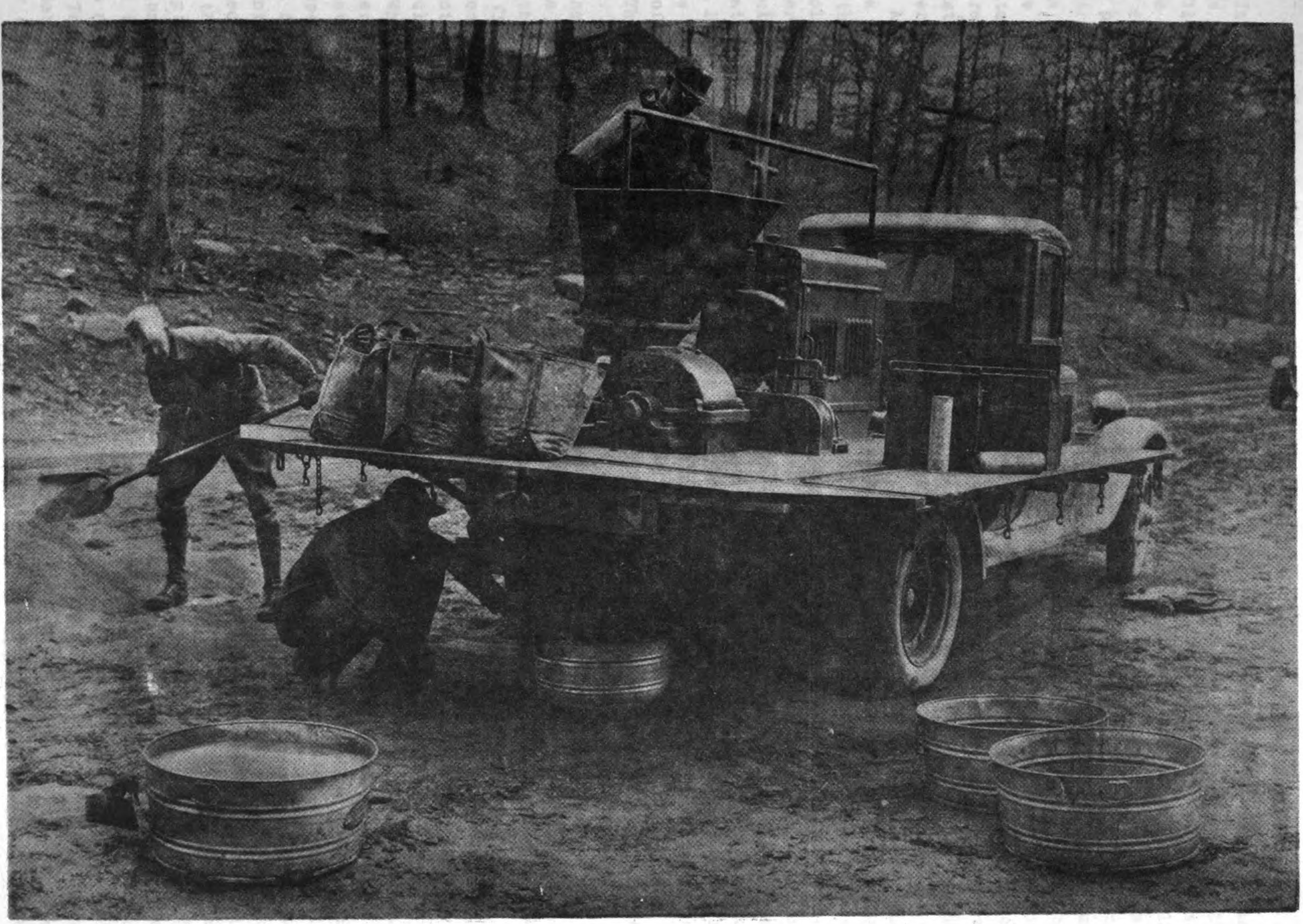


Figure 3.—Construction details of riffle



In order to reduce the manual labor required to reduce the crushed 1,000-pound gross sample to the 5-pound laboratory sample, the coal discharging from the crusher passes through a riffle attached to the discharge hopper of the crusher. This riffle constructed of brass plates and channels as shown in Figure 3 is designed to split the stream of coal into 12 equal streams; alternate streams pass to the right and left side of the riffle, the material which passes to the right being retained for further reduction and that to the left being discharged. The riffle when in service is supported on arms which hook on to the lower flange of the chassis frame. Since the accuracy of the splitting depends on having the riffle clean and the individual plates evenly spaced, the riffle is detached and carried in a suitable box when in transit to prevent its being mutilated or getting the slots plugged with road dirt. When the riffle is removed, the bottom opening of the crusher is protected against road dirt and moisture by a plate pivoted on the cross member just in front of the crusher and clamped to the one behind it by a thumb nut.

As auxiliary equipment the truck carries a pair of United States Bureau of Mines type riffle buckets for further reducing the retained half of the crushed sample; 55 canvas bags like those commonly used by coal dealers in delivering coal, into which the gross samples are collected; four heavy galvanized-iron wash tubs which are used in collecting, mixing and further reducing the retained half of the crushed sample; canvas covers for these tubs; and tarpaulins for covering the gross sample to prevent changes in moisture content and contamination of the sample; long-handled, square-point shovel, broom, hand hammer for breaking large lumps in the gross sample; a supply of the screw-top galvanized-iron cans in which the sample is sent to the laboratory; and a hand line for lowering the bags of coal from the tops of the railroad cars or loader's platform of the tipple.

The methods used in collecting the gross "hand sample" are used in sampling with the truck. A gross sample of about 1,000 pounds of each size of coal shipped is collected during the time it takes to "cover the mine" - that is, for coal to have been received at the tipple from each part of the mine - to insure that the sample be representative of all the coal that may be produced from the mine. It has been found that 1,000 pounds of bituminous coal fills about 12 of the canvas bags, and this number is apportioned to the number of railroad cars of each size loaded while the mine is "covered." As the samples are being collected the bags are grouped according to the size, and each group is kept covered with a tarpaulin to prevent contamination and change in moisture content.

When the gross sample or samples have been completed, each sample is passed through the crusher; one half of the sample is rejected and falls to the ground; the other half is collected in three tubs which are slid under the riffle spout in turn. Figure 4 illustrates the operations. The crushed coal in each tub is then thoroughly stirred and shovelfulls taken from each tub in turn to fill one riffle bucket, which is then dumped, one half of the contents being retained in the second riffle bucket, the other half being discarded. When the second riffle bucket is filled it is dumped back into the first, making the third "split" from the original sample. The retained portion is then transferred to the fourth tub, and this procedure repeated until the retained half of the original sample is disposed of. The portion retained in the fourth tub is then treated in the same way, splitting it three times until the retained portion has been reduced to about 15 pounds. From this the final samples which are to be sent to the laboratory are taken.

Though the procedure in reducing the gross sample does not follow literally the American Standard hand crushing and quartering method, it is quite analagous.[4] In the former method, after crushing, the sample is repeatedly mixed by piling in conical piles which are then flattened out and divided into quarters, alternate quarters being retained. In the latter, the coal is thoroughly mixed in the tubs, shovelfulls are taken from different tubs in rotation, and alternate twelfths are retained. This method may be considered even preferable to the hand crushing method; less opportunity is offered for tampering with the sample, it is not exposed to the elements to so great an extent, and there will be less chance of gaining or losing moisture or being contaminated during the process, as is possible when the sample is spread in a thin layer over a large surface which may not be perfectly clean and may be exposed to wind-blown or falling impurities.

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[4] See Pope, G. S., Directions for Sampling Coal for Shipment or Delivery, Tech. Paper 133, Bureau of Mines, 1917, 15 pp.